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Telecommunications Fundamentals

Please note: This guide was not written by me. The authors are anonymous.

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Telecommunications Fundamentals, Chapter 1: Network Overview

NETWORK OVERVIEW

Objectives

Describe the major components of the network and their interrelationships.

Describe how your voice is converted to electrical signals and transmitted over the network.

Introduction to the Telecommunications Network

Definition of a network:

A system of interconnected elements

A system of various departments to support these elements

A basic network is illustrated in Figure 1.1. When defining a telecommunications network, the concept of traffic must be considered.

Traffic is the flow of information or messages throughout the network

What is a telecommunications network?

A system of interconnected elements linked by facilities (i.e., physical connections) over which traffic will flow.

The traffic may be conversations, information, or complex video or audio services. The telecommunications network must also be able to control the interconnected elements

Two Distinct Types of Networks

At a very basic level, two distinct types of networks can be identified (Figure 1.2):

Direct Connect Network

Centralized Network

Direct Connect Network

In a direct connect network, each network component is directly connected to every other network component (Figure 1.3).

It results in a congested and costly network configuration.

Alexander Graham Bell was responsible for the direct connect network. The direct connection formula is:

$C = U(U-1)/2$

Where: U = Number of Users; C = Number of Connections Advantages:

Private

Customer has complete control over the call (point to point)

The major disadvantages of a direct connect network are:

Expensive

Complex

Railroad Network

Thus, the invention of the telephone and the capability to communicate via the telephone presented a new challenge:

How to allow connection between telephones in different locations without directly wiring the telephones to each other

Theodore Vail was responsible for the telephone network as we know it today. Because of Vail, the early railroads

were used as the model for development of a new kind of telephone network - the centralized telephone network.
Basic Components of the Railroad Network (Figure 1.4):

Hub (switch)

Trunk

Local

Distribution

Centralized Network

A centralized telephone network (Figure 1.5) looks very much like the configuration of a railroad network.

Various network components are connected to a centralized point(such as a switch in a central office) which handles switching and routing functions.

In the centralized network structure, the functions of control and interconnection (i.e., switching) are primary. Centralized systems are virtually unlimited in how large they can become. Their major advantage is that customers can be interconnected through switching centers for worldwide communications. Additional considerations of the centralized network are:

Some loss of control over the call by the customer

The switch controls routing and connection (i.e., if there is excessive congestion a call may be blocked)

Possible loss of privacy (although there are many safeguards against this)

Location of centralized switching system

Capacity

Network Components and Architecture

Physical components required for telecommunication networks are: (Figure 1.6)

Transmission Facilities

Local Loop

IOF - Interoffice facilities

Switching Systems

Customer Premise Equipment (CPE)

Transmission Facilities

In its simplest form, a transmission facility is a communication between two end points. This communication path can also be referred to as:

Channel

Circuit

Trunk

For telephony purposes, the communication path (also known as network facilities) can be classified into two broad categories:

Local Loop

Interoffice Facilities (IOF)/Trunk

The local loop:

is a circuit that connects a customer to the telephone network.

provides the customer with access to the switching system.

The term "loop" is derived from the pair of wires that forms the electrical path between the customer and the central office.

The local loop is also referred to as the subscriber loop.

A simple local loop architecture is depicted in Figure 1.7.

[Editor's note: For another look at the elements of outside plant, click here for my presentation. I think mine is a little more clear]

The CPE is connected to the central office by means of the drop wire, distribution cable, and feeder cable which are cross-connected at specific points. (terminals)

SAI = Serving Area Interface. Also known as a B-Box. (cross-connect box) Interoffice Facilities (IOF):

Consist of trunks that connect switching systems.

Carry multiple transmissions over a single path rather than a single transmission over a single path.

Consist of the necessary equipment on each end, and the facility (i.e. cable) itself.

Historically, copper cable was the facility used. Today, the facility may also be:

coaxial cable

radio links (microwave)

fiber optics

Switching Systems

The primary functions of switching systems are to provide:

Call setup and routing

Call supervision

Customer I.D. and phone numbers

These are accomplished by interconnecting facilities (Figure 1.8). Switching systems located at the central office (CO) that are used to provide dial tone and ringing are referred to as end offices or local switches. These switches can also be interconnected with other switches. Another type of switch, tandem, is used as a hub to connect switches and provide routing. (No dial tone is provided to the customer.)

19 tandems in California. Class 4 offices.

680 end offices or local switches in California. Class 5 switches.

Customer Premise Equipment (CPE)

CPE is the customer's interface with the network (e.g., the telephone set). The telephone set (Figure 1.9) provides for the conversion of acoustical (voice) signals into electrical signals for transmission through the network.

It also generates the addressing (the called number) and supervision signals (on-hook/off-hook, call status).

[Ed. note: for more information on supervision, click here.]

There are many other types of CPE available such as:

Modems (used with computers)

Facsimile machines

Sensors (alarms)

Video camera

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